ATTACHMENT - REMARKS

By this Amendment, independent claims 2, 19 and 20 have been amended for clarity and to better define the invention. Other dependent claims have also been amended consistent with the changes to their independent claims and/or for clarity. Finally, withdrawn claims 27-39 have been canceled; and a new claim 42 has been added. It will also be noted that an IDS accompanies this Amendment. It is submitted that the present application is in condition for allowance for the following reasons.

Information Disclosure Statement

In this section of the Detailed Action, the examiner noted that the IDS filed on 11/17/05 failed to include an explanation of relevance of each patent listed that was not in the English language. On the attached IDS citation listings provided with the Action, only FR 22617723 (Odam) was indicated as not being considered, so it is presumed that this was the only non-English language reference objected to for this reason. Therefore, in order to overcome this problem, a new IDS is submitted herewith re-submitting this FR reference but now with an English language abstract and a machine English language full translation. It will be noted that an additional reference is also submitted.

Claim Amendments

By this Amendment, the following claim changes of note have been made.

Independent claim 2: some limiting and clarifying changes have been made to address the §103 rejection and to better define the invention. In particular, amended claim 2

specifies that the microwave radiation source generates "a stable output frequency in the range of 5 to 60 GHz", and clarifies the operation of the first detector and its relationship with the impedance adjuster.

Independent method claims 19 and 20: corresponding amendments to independent claim 2 noted above have been similarly made therein.

Dependent claims 3 and 4: have been amended to clarify the operation of the optional second and third detectors respectively. The location of the third detector in relation to the first detector has also now been specified in claim 4 (based on Fig. 16, for example).

Dependent claims 5, 6, 12, 18 and 22: minor amendments have been made to improve consistency.

Dependent claim 13: has been amended to specify that the stub tuner has three stubs.

Dependent claims 40 and 41: have been clarified in light of the amendment to independent claim 2; and they now present optical features for the microwave radiation source.

New claim 42: this added claim recites the presence of an amplifying system for the microwave radiation that comprises a solid state amplifier (see, e.g., the passage bridging pages 32 and 33 of the application as filed).

Response to § 103 rejections

US 5,957,969 (Warner) discloses an ablation apparatus in which the impedance of the source is tuneable to that of the transmission line that carries energy to the treatment area. Warner states that the frequency of its treatment energy is up to 3

GHz (see column 4, lines 45-47). To produce energy at this desired frequency, Warner proposes a magnetron as the source of microwave radiation (see column 4, lines 54-55). To tune the apparatus, Warner specifies that a controller is arranged to receive a signal indicative of the magnitude of the reflected power from the directional coupler in order to adjust the tuning mechanism (see column 6, lines 60 to 64).

Amended independent claim 2 specifies that the microwave source produces a stable output signal. Signals produced by magnetrons are unstable, because the output frequency drifts, e.g., due to variations in power supply voltage (pushing) and load impedance (pulling), as well known in the art. Magnetron sources thus require a high voltage supply, which can be difficult to control.

Furthermore, amended independent claim 2 recites tissue ablation apparatus in which both the magnitude and phase of reflected radiation is measured by incorporating a local oscillator into the apparatus (magnitude and phase are measured by comparing the reflected radiation with the signal from the local oscillator). These first two features are related: having a stable source makes accurate phase detection possible.

The arrangement in Warner is thus impractical for detecting both magnitude and phase with a reflected signal, because the source of microwave radiation is too unstable. One advantage of detecting both magnitude and phase as taught by the present invention is that it allows better control of the impedance adjuster.

Independent claim 2 specifies further that the output frequency from the microwave radiation source is in the range 5 to 60 GHz, which is greater than the range proposed in Warner. Using higher frequencies in combination with the accurate detection of magnitude and phase enables the apparatus of the present invention to

react to variations in impedance at the probe tip more rapidly. This can be demonstrated when one considers the triple stub tuner as the impedance adjuster. The stub tuner effectively acts as a resonant cavity; when higher frequencies are used, smaller adjustments are required to the resonant cavity to have an effect. For example, a particular impedance adjustment that requires a stub travel distance of 60 mm in Warner can be achieved by a stub travel distance of about 10 mm in the present invention. This demonstrates that the present invention may therefore have an improved adjustment speed compared with the apparatus disclosed in Warner.

In the Office Action the examiner acknowledges that Warner does not teach use of a local oscillator in its power monitor, but alleges that it would have been obvious to use a heterodyne receiver as a power monitor from the disclosure of US 6,256,130 (Bulow). However, Bulow relates to a technique for reducing chromatic dispersion in an optical communication network. Optical radiation has a frequency that is four orders of magnitude greater than microwave radiation. Chromatic dispersion is a pulse broadening effect, not a reflectance problem. Bulow is therefore of no relevance whatsoever to the present invention; in particular, a skilled person would not consider it when seeking to improve the tissue ablation apparatus of Warner, for example.

In fact, no prior art documents have been cited that disclose or suggest that apparatus for tissue ablation would be improved by using a tuning arrangement in which the magnitude and phase of reflected signals are detected. Warner provides no motivation for a skilled person to detect both the magnitude and phase; Warner only discusses detecting the magnitude of power signals, and there is no hint as to how such a system would be improved by the use of alternative power sources.

A limitation of using a non-stable frequency source (e.g. a magnetron) is that the signal measurement accuracy (magnitude in Warner) is limited due to parameter variation in the microwave components used in the measurement system over a range of frequencies. For example, there will be a variation in coupling factor and directivity of the first and/or second and/or third coupler(s) used in the system. This parameter variation limits the effectiveness of impedance matching. By using a stable source, the present invention can avoid this limitation.

The present application discloses an improved tissue ablation apparatus. The improvement is achieved by providing both a stable microwave radiation source and magnitude and phase detection and also by incorporating the **additional** understanding that using such a detection system with higher treatment frequencies results in an apparatus that is superior in accuracy and reaction speed to known devices. None of the cited documents, taken singly or in combination, suggest moving towards this combination.

Therefore, for all of the foregoing reasons, it is submitted that amended independent claim 2 defines an invention that is novel and non-obvious over the cited prior art so that amended claim 2 is now allowable. For these same reasons, it is submitted that independent method claims 19 and 20 are similarly allowable. Finally, as all of the remaining claims are dependent from one of the allowable independent claims, it is submitted that all dependent claims are allowable for the same reasons as the independent claims from which they depend.

Amended dependent claim 4 recites that the third detector is "connected between the source and the probe of the opposite side of the impedance adjuster from

the first detector". The third detector is shown in Fig. 16 and discussed in the description at the passage from page 26, line 16 to page 27, line 6. This passage makes clear that the different position of the third detector compared with the first detector produces extra information beyond a mere duplication of the first detector.

Amended dependent claim 13 defines the particularly advantageous example of a three-stub tuner as the impedance adjuster. This example is advantageous because all possible complex impedances within a given range are obtainable by adjusting the three-stub tuner alone. Other arrangements require more than one impedance tuning device in order to achieve the same coverage. A system that uses only two tuning stubs, such as that proposed in Warner, is limited in terms of the range of tissue impedances that the system can effectively match with. It should be noted that without a means of adjusting the length of the transmission cable (using, for example, a variable length of transmission line), the inaccessible range of impedances may fall inside the range that is of interest.

New claim 42 recites a microwave amplifying system comprising a solid state amplifier. With this feature, the tissue ablation apparatus of the invention may provide better power control than the system described in Warner. Output power level control in Warner is limited because the output power produced by the magnetron needs to be controlled by pulse width modulation. In contrast, the present invention can use a solid state amplifier as a means of producing power levels that are useful for tissue ablation. In combination with the stable frequency source, the solid state amplifier enables lower power levels to be controllably generated to enable effective treatment of small tissue structures.

Therefore, for these additional reasons, it is submitted that the noted dependent claims are additionally allowable.

For all of the foregoing reasons, it is submitted that the present application is in condition for allowance and such action is solicited.

Respectfully submitted,

Date: January 22, 2010

/Douglas E. Jackson/

Signed By
Attorney of Record

Name: Douglas E. Jackson
Registration No.: 28,518

STITES & HARBISON PLLC ◆ 1199 North Fairfax St. ◆ Suite 900 ◆ Alexandria, VA 22314
TEL: 703-739-4900 ◆ FAX: 703-739-9577 ◆ CUSTOMER NO. 881